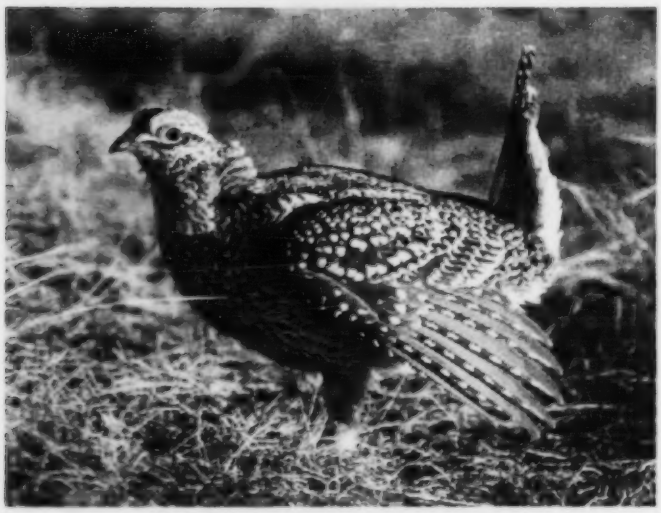
STATUS OF THE SHARP-TAILED GROUSE (*Tympanuchus phasianellus*) IN BRITISH COLUMBIA



by

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EXECUTIVE SUMMARY

Sharp-tailed Grouse (*Tympanuchus phasianellus*) are widely distributed in British Columbia. Two subspecies, the "Alaskan" and "plains" (*T.p. caurus and T.p. jamesi*), occur in northern British Columbia, and are associated with openings in forested areas and aspen complexes. A third subspecies, the "Columbian" (*T.p. columbianus*), occurs as an isolated metapopulation in the central and southern portions of B.C.'s interior. It occupies both climax grasslands and openings in forested areas.

Information on the northern subspecies' distribution range and population status in British Columbia is largely unknown; therefore, it is not possible to assign a ranking to these subspecies.

The "Columbian" subspecies is currently on the provincial Blue List. "Columbian" sharp-tails have benefited from large-scale clearcut harvesting in the northern part of their range, but they have suffered significant declines in climax grasslands. "Columbian" sharp-tails are extirpated from the Okanagan, and are virtually extirpated from the Rocky Mountain Trench. In the Thompson Nicola region, populations appear to be stable at comparatively low numbers. Habitat loss and degradation are responsible for the observed declines in populations of this subspecies. Grassland and riparian habitats have been lost to urban and agricultural development and forest encroachment. In the Kootenays, important wintering riparian habitat has been lost to flooding. In the remaining grasslands, grazing practices have been implicated in the degradation of nesting and winter cover. Because these factors continue to threaten this subspecies, and since there is no possibility of "rescue" effect from outside sources, the author recommends that the Blue List status for this subspecies be maintained.

Priority management activities include carrying out baseline studies to identify distribution, validity of subspecies designations, population sizes and trends, source/sink dynamics, and habitat associations for all subspecies.

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1 INTRODUCTION

The Sharp-tailed Grouse (*Tympanuchus phasianellus*) is one of four species of grouse that inhabit steppe, grassland and shrub habitats[1]. Historically, Sharp-tailed Grouse were distributed over most of the central and western United States and western Canada. Seven recognized sub-species of Sharp-tailed Grouse occur in North America (Connelly et al. 1998). Three subspecies are recognized in British Columbia: "Columbian" (*T.p. columbianus*), "Alaskan" (*T.p. caurus*), and "plains" (*T.p. jamesi*) (Cannings 1998).

Sharp-tails have been extirpated from a large portion of their former range (Ammann 1963). The "Columbian" subspecies has seen the most dramatic declines. Historically, this subspecies occurred in California, Oregon, Washington, Nevada, Idaho, Utah, Montana, Colorado, Wyoming, New Mexico, and British Columbia. By 1970, populations had disappeared from New Mexico, California, Nevada, and Oregon (Schroeder et al. 2000). Most of the remaining populations occupy highly fragmented areas and most are exhibiting declining trends (Connelly et al. 1998). Populations of the "Alaskan" and "plains" subspecies appear to be secure, although declines for the "plains subspecies have been reported (Sauer et al 2001; NatureServe Explorer 2002).

Population dynamics and trend information for Sharp-tailed Grouse in British Columbia is limited. The status and distribution of northern populations of sharp-tails (*T.p. caurus, T.p. jamesi*) and the northern range of the "Columbian" subspecies (*T.p. columbianus*) is largely unknown (Ritcey 1995; Connelly et al. 1998). However, population declines have been reported for "Columbian" sharp-tails in grasslands of the south-central interior (Leupin 2000a), and this subspecies has been extirpated as a breeding population from the east Kootenays and the Okanagan Valley (Ritcey 1995). The Sharp-tailed Grouse is currently ranked at-risk provincially as a Blue-listed species.

The main factors for the decline of "Columbian" Sharp-tailed Grouse include historic over-exploitation and the loss, degradation and fragmentation of their habitat (Buss and Dziedzic 1955; Campbell et al. 1990; Schroeder et al. 2000). Excessive livestock grazing, agriculture, loss of habitat due to hydro-electric dam flooding, urban sprawl, herbicide and pesticide application, and the exclusion of fire from grassland ecosystems are all thought to be contemporary contributing factors to the decline of this species (Tirhi 1995).

The purpose of this report is to synthesize current information relevant to Sharp-tailed Grouse populations in British Columbia, identify knowledge gaps, and summarize population trend information that will permit a re-evaluation of the status of this species in British Columbia.

An earlier status report by Ritcey (1995) provides a thorough literature review and valuable comments on the status of the "Columbian" subspecies. This report builds on the 1995 report by incorporating the latest information on the "Columbian" subspecies. In addition, this report includes the current state of knowledge on the two northern subspecies, which have for the most part, received little or no attention by scientists or wildlife managers (B. Webster, M. Schroeder, K. Mock, pers. comm.).

2 SPECIES INFORMATION

2.1 Name and Classification

Sharp-tailed Grouse belong to the order Galliformes, commonly referred to as upland game birds. They are in the family Phasianidae, the genus *Tympanuchus*, and the species *phasianellus* (Johnsgard 1973). Seven subspecies are recognized in North America (Connelly et al. 1998). Three subspecies occur in British Columbia: "Columbian" (*T.p. columbianus*), "Alaskan" (*T.p. caurus*), and "plains" (*T.p. jamesi*) (Cannings 1998; Connelly et al. 1998).

2.2 Description

Sharp-tailed Grouse are medium-sized (40-48 cm long, 500-1000 g) birds. Both sexes are cryptically colored. Upper body is heavily barred with dark brown, black, and buff. The underside is typically white with tawny margins (Connelly et al. 1998).

[1] Others are Sage Grouse, Lesser Prairie Chicken, and Greater Prairie Chicken

Males can be distinguished from females by having darker crown feathers and a continuous dark line along both sides of the central rectrices. Males also have a yellow orange comb over each eye, and a pale violet airsac. Both the airsac and the eyecombs are exposed during breeding displays.

Similar species include the Greater Prairie Chicken (*T. cupido*) and the Lesser Prairie Chicken (*T. pallidicintus*). These are not recorded in British Columbia.

3 BIOLOGY

3.1 Reproduction

3.1.1 Mating behaviour

The Sharp-tailed Grouse is the only extant species of grouse in British Columbia that exhibits lekking behaviour. During spring, and to a lesser extent in fall, males congregate and defend territories in traditional areas known as dancing grounds or leks. Common display behaviours at leks include rapid foot stomping with outstretched wings ("dancing"), squatting and facing other males at territory boundaries, and quick runs along territory boundaries or towards other males. Dominant males occupy territories near the centre of the lek while subdominant and juvenile males defend territories at its periphery. Males that successfully maintain a territory near the centre of the lek mate more often and are less likely to be depredated (Gratson et al. 1991). Although no breeding occurs during the fall, lek attendance at this time is likely influenced by weather conditions and photoperiods that are similar to those during the spring breeding period (Moyles and Boag 1981) or to establish pre-breeding hierarchies (Gratson 1988). Females visit the lek during the breeding season (March-June) (Cannings 1998). In British Columbia's southern interior grasslands, peak visits by females occur mid-to late April (D. Jury, pers. comm.). Later visits by females may represent second mating attempts after an initial nest failure (Meints 1991).

3.1.2 Nesting and incubation

After copulation, females leave to find suitable nest sites. Nests consist of small depressions, which are loosely lined with residual grass, leaves, mosses, and feathers (Campbell et al. 1990; Leupin 2001). Nests are usually within 2 km of the lek, and are often in areas where vegetation density is greatest (Giesen and Connelly 1993; Schroeder et al. 2000). Average distances between nests and leks for the "Columbian" and "plains" subspecies is 1.6 km (Pepper 1972; Giesen and Connelly 1993; Schroeder 1996). No data is available for the "Alaskan" subspecies.

In British Columbia, information on nest location relative to leks is available only for the "Columbian" subspecies in climax grasslands of the Thompson-Nicola region. Jury (unpubl. data) found four nests within 1600 m of the lek. A fifth nest was located 2400 m from the lek. Leupin (2001) reported that four radio-collared females nested on average, 1199 m (range 296-1801 m) from the lek during the first nesting attempt. Re-nesting attempts averaged 1517 m (range 463-2663 m) from the lek. Distances between first and second nesting attempts were 91 m, 169 m, and 2880 m.

Incubation typically begins after the last egg has been laid, and lasts 21–23 days (Campbell et al. 1990). Only the female incubates (Connelly et al. 1998).

Nesting, oviposition, and hatching dates vary with weather and latitude. In general, dates for these activities are later during cold springs and in northern areas (Connelly et al. 1998). Dates for 19 clutches recorded in British Columbia for all subspecies were between April 22 and July 11, with 52% of them occurring between May 7 and June 21 (Campbell et al. 1990). In the southern interior, incubation dates of first clutch and peak hatch by "Columbian" sharp-tails ranged from May 5 to 10 and May 20 to June 11, respectively (Leupin 2001, D. Jury, unpubl. data). Nesting, incubation, and hatch phenology for the "Alaskan" and "plains" subspecies in B.C. is not known.

The average number of eggs in the first clutch ranges from 7.9 to 12.3 (Table 1). Meints (1991) reported lower numbers of eggs in re-nesting attempts. In British Columbia's southern interior, the average number of eggs for the "Columbian" subspecies in two re-nesting attempts was 11 (Leupin 2001).

Nesting success for "Columbian" and "plains" sharp-tails ranges between 50 and 72% (Hamerstrom 1939; Marks and Marks 1987; Meints 1991). In B.C., hatching success rates for all subspecies are unknown.

Table 1. Average (range) first-clutch sizes of two subspecies of Sharp-tailed Grouse in various areas.

Location	Subspecies	Mean clutch size (range)	Source
British Columbia	"Columbian"	11.2 (8-13)	Leupin 2001
British Columbia	"Columbian"	7.9 (5-13)	Campbell et al. 1990
Washington	"Columbian"	10.5	Schroeder 1996
Idaho	"Columbian"	11	Marks and Marks 1987
Saskatchewan	"plains"	12.3	Pepper 1972

However, Leupin (2001) and Jury (unpubl. data) reported nesting success rates of 0% (n=4) and 75% (n=4), respectively, for radio-collared females of the "Columbian" subspecies in grasslands near Kamloops, B.C.

3.1.3 Brood rearing

One brood is produced annually. Campbell et al. (1990) stated that 56 broods found in British Columbia ranged in size from 1 to 14 young, and averaged 5.6 young. In climax grasslands near Kamloops, B.C., Leupin (2001) found two broods ("Columbian" subspecies) of six and five young 35 days after hatching.

Young can walk soon after hatching, and are capable of flight when they are 7-10 days old. In his study near Kamloops, Leupin (2001) found that one female and her brood had remained within 680 m of the nest in the first 35 days after the chicks had hatched. A second female and her brood moved 1036 m within the first five days after hatching. After 35 days, they had moved 2084 m from the nest. Movements by both females were in the direction of the lek of origin.

Sharp-tailed Grouse have high reproductive potential, therefore, chick survival may influence population dynamics significantly (Hays et al. 1998). Bergerud (1988) summarized results from eight studies of several subspecies and determined that chick mortality until fall was less than 40%. Giesen (1987) and Marks and Marks (1987) reported "Columbian" chick mortality rates until fall of 34% and 50% in Colorado and Idaho. In British Columbia, mortality rates for all three subspecies are unknown.

3.1.4 Sex ratio

Sex ratio is believed to be 1:1 (Ritcey 1995). In a summary of four studies, Bergerud (1988) reported male:female ratios of 52:48 for juveniles, and 53:47 for adults (all subspecies combined). In British Columbia, a sample of 102 museum specimens collected outside of the breeding and fall congregation periods showed a male: female ratio of 56:44 (Ritcey 1995).

3.2 Survival

No mortality estimates are available for British Columbia (Ritcey 1995). Bergerud (1988) reported mortality rates of 60% and 75% for all subspecies of sharp-tails combined. Robel et al. (1972) estimated mortality rates of 70.4% and 71.5% in two study areas in North Dakota. In Washington, Schroeder (1994) reported mortality rates of 40% for radio-collared birds.

Increased mortality rates appear to coincide with spring and fall dancing periods and with increased winter severity. Marks and Marks (1988) reported that 94% of their radio-collared birds were killed during the spring and fall dancing periods. In Idaho, Ulliman (1995) reported mortality rates of 14% and 71% for a small sample of birds during mild and severe winters, respectively.

3.3 Physiology

Sharp-tails are non-migratory, therefore, they must be able to withstand harsh environmental conditions during winter and summer droughts. Sharp-tails thermoregulate by selecting suitable habitats and postures that regulate heat balance (e.g., snow roosting) (Evans and Moen 1975). The importance of water sources to Sharp-tailed Grouse is poorly documented. Marks and Marks (1987) did not observe sharp-tails near open water, but in grasslands near Kamloops, B.C., birds were consistently flushed from the shore of a small

pond during the breeding season. The birds, however, were likely using the riparian vegetation for cover (E. Leupin, pers. obs.). Oedekoven (1985) believes sharp-tail water requirements are satisfied by the foods they consume. During winter, they may also eat snow (Aldous 1943 in Connelly et al. 1998).

3.4 Movements/Dispersal

3.4.1 Migration

Sharp-tails are not considered to be migratory, although some populations display a partial migration between wintering and breeding areas (Hay et al. 1998). In Washington, "Columbian" Sharp-tailed Grouse moved 14 km to wintering grounds (Schroeder 1994). Meints (1991) reported movements of 20 km to wintering grounds. These long-distance movements may indicate poor winter habitat quality (Meints 1991). In grasslands near Kamloops, B.C., a small sample (n=7) of radio-collared "Columbian" males remained within 600 m of the lek of capture throughout the winter (Leupin 2000b).

3.4.2 Home range

Sharp-tailed Grouse have small annual home ranges. In British Columbia's climax grasslands, all "Columbian" radio-collared birds (male and female) have been located within 2.8 km of the lek of capture (Van Rossum 1992; Leupin 2001; D. Jury, unpubl. data.). One collared female, however, moved more than 8 km from the lek during winter (D. Jury, unpubl. data.). The estimated winter home range for two males was 2.1 km^2 and 3.8 km^2 (Leupin 2000b). In Idaho, home ranges for the "Columbian" subspecies averaged 1.87 km^2 (Meints 1991). In Montana, average male and female home ranges for transplanted Sharp-tailed Grouse were 1.7 km^2 (n=6) and 3.6 km^2 (n=2), respectively (Cope 1992) (see also nesting and brood rearing above). No information is available for the "plains" and "Alaskan" subspecies in British Columbia.

3.5 Nutrition and Interspecific Interactions

3.5.1 Diet

Adult Sharp-tailed Grouse feed primarily on native vegetation throughout the year, although cultivated grains and insects supplement their diet (Marks and Marks 1987; Giesen and Connelly 1993; Hays et al. 1998). Chicks, however, depend on insects as a food source during the first five weeks after hatching (Johnsgard 1983). In spring and summer, the bulk of the diet consists of greens, buds, and fruits from grasses, herbs, and shrubs (Tirhi 1995; see Connelly et al. 1998 for detailed list of food items). Summer dietary habits for all subspecies of sharp-tails in B.C. are poorly documented. Winter foods include buds, seeds, herbs, and fruits (Hays et al. 1998). In the southern interior of B.C., buds of water birch (*Betula occidentalis*) are an important winter food item (Van Rossum 1992; Ritcey 1995; Leupin 2000b). Other important forage species include wild rose (*Rosa* spp.), saskatoon (*Amelanchier alnifolia*), choke cherry (*Prunus virginiana*), and willow (*Salix* spp.). In northern B.C., winter foods for all three subspecies include buds of scrub birch (*Betula glandulosa*), trembling aspen (*Populus tremuloides*), and buds and fruits from other deciduous trees and shrubs (Ritcey 1995). Studies elsewhere have documented reliance on grain as a winter food source (Connelly et al 1998). In British Columbia, grain fields are generally uncommon, and thus, do not provide a critical food source for sharp-tails except in the Peace River area.

3.5.2 Interspecific Interactions

Interspecific interactions are poorly documented (Hays et al. 1998). Nest parasitism by Ring-necked Pheasants (*Phasianus colchicus*) on "plains" sharp-tails (*T.p. jamesi*) has been reported (Vance and Westeneier 1979 in Hays et al. 1998). In British Columbia, sharp-tails may have interacted with Ring-necked Pheasants in the southern portion of their range, however, nest parasitism has not been documented there. In many B.C. jurisdictions, pheasant releases are prohibited in areas where Sharp-tailed Grouse occur (D. Fraser, pers. comm.).

Sharp-tailed Grouse have been reported to hybridize with Greater Prairie Chickens (*T. cupido*) and Blue Grouse (*Dendragapus obscurus*). However, hybridization has not been reported in British Columbia. In B.C., Sharp-tailed Grouse range overlaps with that of the Blue Grouse, Ruffed Grouse (*Bonasa umbellus*), Chukar (*Alectoris chukar*) and Spruce

Grouse (*Dendragapus canadensis*). Historically, the sharp-tail range in the south Okanagan would have overlapped with that of the Sage Grouse (*Centrocercus urophasianus*).

3.5.3 Behaviour/Adaptability

Sharp-tails are the only remaining tetraonid in British Columbia that gathers on traditional dancing grounds to breed (see breeding behaviour above). The Sage Grouse, another lekking species, has been extirpated as a breeding bird in British Columbia. Although sharp-tail dancing grounds are traditional, displaying males may move short distances to alternate display areas if the original dancing grounds are altered (Sexton and Gillespie 1979; Tirhi 1995). Males (adults and juveniles) also congregate on the dancing ground during fall (non-breeding), presumably to establish their position in the hierarchy, or as a response to photoperiods that are similar to those during the breeding season (Connelly et al. 1998; Hays et al. 1998). Females may also visit dancing grounds at this time (Lumsden 1965). Rippin (1970) reported two females were among 14 birds shot near a dancing ground during fall in Alberta.

Sharp-tails are highly social. Flocks composed exclusively of males or broods gather in fall and winter (Connelly et al. 1998). In Idaho, winter flock sizes ranged from 5 to 22 birds (Meints 1991). In British Columbia, flocks of 7-72 birds have been reported (Ritcey 1995; Leupin 2000b).

4 HABITAT

4.1 Habitat Requirements

4.1.1 General

Sharp-tailed Grouse use a variety of habitats, although the presence of open areas juxtaposed with shrubby and/or open parkland is common to all occupied areas. In British Columbia, sharp-tails have been found at elevations from 275 to 2135 m (Campbell et al. 1990).

Elsewhere in North American, the Sharp-tailed Grouse, particularly the "Columbian" subspecies, is commonly associated with sagebrush communities (Saab and Marks 1992; Ritcey 1995; M. Schroeder, pers. comm.). In British Columbia, the "Columbian" subspecies is mainly associated with two habitat types: mid- and upper-elevation climax grasslands with little or no sagebrush in the Bunchgrass, Ponderosa Pine, and Interior Douglas-fir Biogeoclimatic zones, and sedge meadow/riparian complexes and seral grasslands resulting from harvesting or fires in lodgepole pine forests in the Interior Douglas-fir, Sub-boreal Pine-Spruce, and Sub-boreal Spruce Biogeoclimatic zones (Ritcey 1995).

In the boreal forests of northern B.C., Sharp-tailed Grouse occupy aspen parkland, swamps, meadows, muskegs, cranberry bogs, burns and cutover areas (Campbell et al. 1990). In the Yukon Territory, the "Alaskan" subspecies is associated with fire-maintained meadow habitats, and areas of gravel outwashes that support aspen parklands (Mossop 1979). Sharp-tails in the Peace River area of northeastern B.C. primarily occur in agricultural lands, and to a lesser extent, habitats similar to those used by birds in the northwest (B. Webster, pers. comm.).

4.1.2 Breeding

Leks, or dancing grounds, are the focal area of the breeding season. Leks may be located on knolls, drumlins and benches, sand dunes, forest clearcuts, meadows, and recent burns (Mossop 1979; Ritcey 1995). For the "Columbian" subspecies inhabiting climax grasslands, leks are typically located on sites that are higher than the surrounding area (Giesen and Connely 1993; Ritcey 1995). In forested habitats, leks are generally located in large openings (usually the result of logging) at least 200+ metres from the forest edge (K. McKenzie, pers. comm.).

The vegetation associated with leks consists of reduced grass and forb layers that provide some cover, but which also afford good visibility. The degree of "openness" varies greatly between lek sites. In forested habitats, sharp-tails usually select recently harvested areas, however, some leks have been reported in areas where tree regeneration exceeds 4 m in height (K. McKenzie, pers. comm.).

In climax grassland communities, established leks may be used for more than 40 years, although their exact location may shift over time. Smaller satellite leks often form in the vicinity of historic leks

(Schroeder et al. 2000; E. Leupin, pers. obs.). In forested areas, leks may persist for more than 20 years. However, longevity of the lek site is likely dictated by silvicultural treatments, fire frequency, and other factors that affect forest regrowth and succession.

4.1.3 Nesting

Females nest soon after mating (May-June). Nests are located on the ground, and are typically situated in open grassy areas (Ritcey 1995). Females nest within 2.4 km of the lek (Pepper 1972; Cope 1992; Schroeder 1996; Leupin 2001).

Availability of suitable nesting sites is considered a limiting factor for sharp-tails. Grasslands in excellent condition are preferred for nesting. A lack of abundant cover (especially residual vegetation from previous year's growth) has been identified as a major factor contributing to poor nesting success (Pepper 1972; Meints 1991). In a study of "Columbian" Sharp-tailed Grouse habitat selection in grasslands near Kamloops, B.C. (D. Jury, unpubl. data), five nests of radio-collared sharp-tails were located. Four of these were on gentle slopes under residual clumps of bluebunch wheatgrass (*Elymus spicatus*), the other was in a dense stand of Kentucky bluegrass (*Poa pratensis*). Leupin (2001) described six nests in the same area. Five of these were in dense stands of climax grasses and herbs, which included rough fescue (*Festuca scabrella*), bluebunch wheatgrass, and arrow-leaved balsamroot (*Balsamorhiza sagittata*). The sixth nest was in a dense stand of Kentucky bluegrass. Mean nest cover for all six nests was 60% (range 30%-90%). Mean vegetation height at all nest sites was 36 cm (range 27-45 cm).

Campbell et al. (1990) reported on 30 nests (subspecies combined) found in B.C. Fifteen were in grassy openings, the remainder were under sparse canopies of lodgepole pine (*Pinus contorta*), ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), and trembling aspen. All were concealed under branches or clumps of grass. Elsewhere in North America, the "Columbian" subspecies prefers to nest where shrubs are abundant. Nests are built between or under shrubs (Tirhi 1995). In Idaho, shrub density in nesting habitat was 11 000 shrubs/ha (Meints et al. 1992); in Colorado, it was 32 500 shrubs/ha (Giesen 1987).

Pepper (1972) described 37 nests of the "plains" subspecies. Seventeen nests were in native grass and shrub, 13 were in tame hay fields, and 7 were in the previous year's grain stubble.

4.1.4 Brood rearing

Sharp-tailed Grouse are precocial. Young move away from the nest site with the female soon after hatching. Insect availability is critical for the young during the first few weeks after hatching (Kobriger 1995). Adequate brood habitat includes open and shrub habitats with abundant insects and sufficient cover (Meints 1991; Ritcey 1995). Leupin (2001) found that radio-collared females and their broods in climax grasslands of south-central B.C. spent the pre-fledging stage in, or near, seepage areas and swales that supported shrubs (mean height = 150 cm), and tall grasses and herbs (mean height = 60 cm). During this period, broods also used aspen copses with a dense understorey of shrubs and tall grasses. After fledging, broods used open grasslands most frequently, however, aspen copses were also used for security cover. Elsewhere, brood habitat is also associated with higher cover of shrubs and broadleaf trees. Cope (1992) found that "Columbian" females with broods used areas with the highest vegetative cover and height. Schroeder (1996), Oedekoven (1985) also found broods using grassland-shrub transition zones In the Yukon Territory, Mossop (1979) found meadow edges provided important brood habitat for the "Alaskan" subspecies.

4.1.5 Winter

Sharp-tailed Grouse habitat requirements are more restricted during the winter months (Meints 1990; Ritcey 1995). Habitats used by all species for foraging and thermal cover include upland shrub communities, aspen complexes, forest edges and riparian habitats (Pepper 1972; Mossop 1979; Moyles 1981; Marks and Marks 1987). In Idaho, Sharp-tailed Grouse winter habitat consisted of shrub patches on hillsides (Marks and Marks 1987). In Washington, sharp-tails relied on stands of water birch, choke cherry and big sagebrush (*Artemisia tridentata*) (Hays et al. 1998). In grasslands near Merrit, B.C., Van Rossum (1992) found that

"Columbian" Sharp-tailed Grouse selected habitats other than open grassland when snow was present. Similarly, Leupin (2000b) reported that "Columbian" Sharp-tailed Grouse near Kamloops, B.C. showed a preference for habitat types other than open grassland and open forest (Figure 1), and that use of these habitats was strongly related to presence/absence of snow. Mean distances to shrub/riparian cover were 10 m and 139 m during snow and snow-free periods, respectively (Leupin 2000b).

Shrub/treed habitats used by sharp-tails during winter in climax grassland communities in the southern interior of B.C. are dominated by trembling aspen, black cottonwood (*Populus balsamifera*), and Douglas-fir (*Pseudotsuga menziesii*) in the canopy. Shrub habitats are dominated by water birch, choke cherry, common snowberry (*Symphoricarpos albus*), saskatoon, red-osier dogwood (*Cornus stolonifera*) and prickly rose (*Rosa acicularis*).

Important forage species for wintering sharp-tails in British Columbia include water birch, scrub birch, willow, saskatoon, rose, and aspen (Ritcey 1995; Leupin 2000b; D. Jury, pers comm.). In agricultural areas in the Peace River region, sharp-tails use grain during winter periods (B. Webster, pers. comm.).

4.2 Trends in Habitat Quality and Quantity

4.2.1 General

Urbanization, succession of grasslands and shrublands to forests, fire, forest harvesting, and conversion of native habitat to agriculture all affect Sharp-tailed Grouse populations and habitat availability and quality (Moyles 1981; Ritcey 1995; Schroeder 1996). Habitat loss and degradation has been most dramatic in climax grasslands and shrub-steppe habitats occupied by the "Columbian" subspecies. The geographic distribution of this subspecies in North America has contracted by an estimated 90% (Miller and Graul 1980). The extent of range loss for the "prairie" and "Alaskan" subspecies is largely unknown.

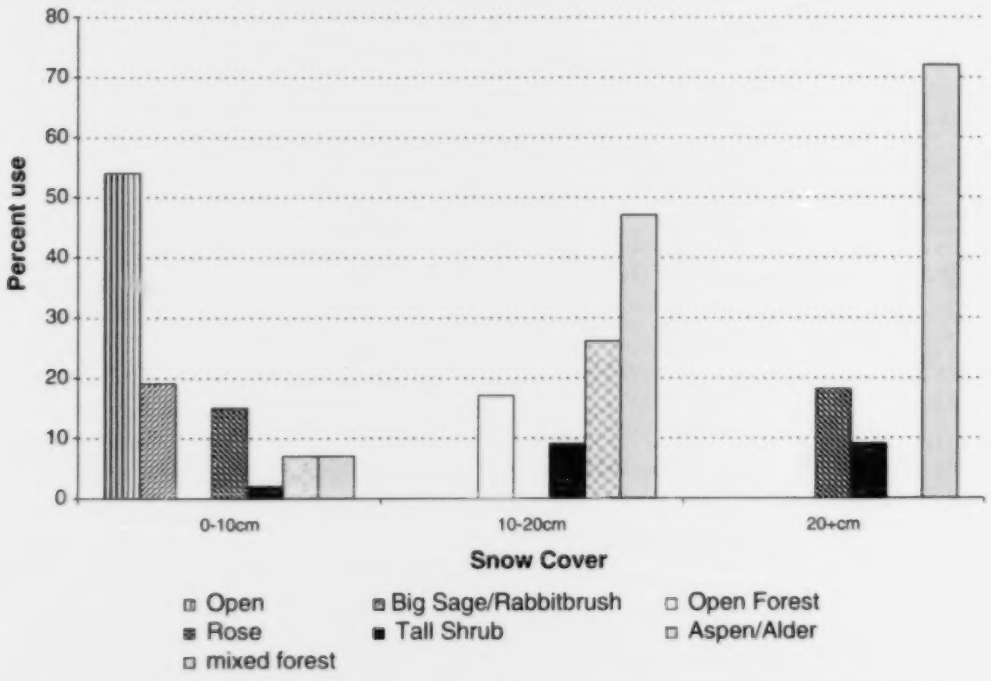

Figure 1. Winter habitats used by "Columbian" Sharp-tailed Grouse in relation to habitat availability and snow depth in climax grassland systems near Kamloops B.C. Adapted from Leupin (2000).

4.2.2 British Columbia

In British Columbia, the extent of sharp-tail habitat alteration is difficult to quantify because all three subspecies occur in forested ecosystems. In these habitats, colonization/extinction rates are influenced primarily by the extent and frequency of forest harvesting activities, natural disturbance events (e.g., fire), and other habitat alterations within private land holdings (B. Webster, P. Dielman, pers. comm.).

Cannings (2002) states that the distribution of the "Columbian" subspecies in British Columbia has seen marked declines over the past 100 years. The estimated overall range of viable populations of this subspecies in the province, based on minimum convex polygon calculations, is 60 000 km^2. (Cannings 2002). Although this estimate takes into account realistic amounts of suitable habitats resulting from forest harvesting cycles (approx. 20%), it does not account for unsuitable habitats within the occupied areas (Ritcey 1995). Actual occupied habitat then, is estimated at 15 000 km^2 (D. Jury, pers. comm.). When ecosection areas of occurrence are summed, they show that *T.p. columbianus* has been extirpated from 22% of its original occupied range, and is declining in 19% of its remaining range (MWLAP 2001).

The extent of loss and degradation of Sharp-tailed Grouse habitat in British Columbia has not been well documented. Some studies have investigated the extent of forest in-growth and encroachment in climax grasslands and open forests in areas occupied by the "Columbian" subspecies. In the southern Rocky Mountain Trench, Gayton et al. (1995) estimated yearly forest encroachment and in-growth rates at 1% and 3%, respectively, over a thirty-year period. In a similar study conducted in grasslands of the Cariboo region, Ross (1997) reported a 30-40% decrease in grassland area, and up to 30% in-growth of grasslands and open forests over the same period. Forest encroachment in grasslands of the Kamloops region is estimated at 17 715 ha (15%) (Ministry of Forests (1999).

For both *T.p. caurus* and *T.p. jamesi*, the extent of habitat loss and degradation is largely unknown. Anecdotal information suggests that habitat loss and degradation may be occurring in areas of the Peace River Lowlands that are occupied by the "plains" subspecies (B. Webster, pers. comm.). With the development of the oil and gas industry, the Land Act requires that individuals holding agricultural lease agreements develop (cultivate, graze, or build structures) 25-80% of the leased area to qualify for its purchase and preclude development by the oil and gas industry. Furthermore, a shift from primarily grain crop to cattle production in this region may also be causing habitat impacts (B. Webster, pers. comm.).

4.2.3 Adjacent jurisdictions

Reliable habitat trend information for the columbianus subspecies is available only from Washington State. Schroeder et al. (2000) estimated that the subspecies' historic range was 79 865 km^2. The current range is estimated at less than 3% (approx. 2234 km^2) of the original, and is comprised of eight disjunct areas that range in size from 61 to 513 km^2 (Schroeder et al. 2000). In Alberta, the historical distribution of the "plains" subspecies is largely unknown, however, habitat loss and degradation of native grasslands and aspen parklands where "plains" sharp-tails occur, is estimated at 80% and 95%, respectively (Alberta Prairie Conservation Action Plan 2001).

5 DISTRIBUTION

5.1 Global/North America

The Sharp-tailed Grouse (all subspecies combined) is found from north-central Alaska, the Yukon Territory, the Northwest Territories, northern Manitoba, northern Ontario, and central Quebec south to eastern Washington, northeast Utah, and Colorado. It occurs in the Great Plains from eastern Colorado to northern Minnesota, northern Wisconsin, and northern Michigan.

The general extent of occurrence of the three subspecies known to occur in British Columbia is as follows:

The "Columbian" subspecies is resident from northern British Columbia south to eastern Washington, western Montana, northern Utah, and western Colorado. "Columbian" Sharp-tailed Grouse range formerly extended to California, Nevada, and New Mexico.

The "Alaskan" subspecies is resident in north-central Alaska east to the southern Yukon Territory, northern British Columbia, and northern Alberta.

The "plains" Sharp-tailed Grouse is resident from northeastern B.C., north-central Alberta and central Saskatchewan south to Montana (except the extreme west), northeastern Wyoming, northeastern Colorado, portions of Nebraska, South Dakota, and North Dakota. Its range formerly extended to Kansas, Oklahoma, and New Mexico.

5.2 British Columbia

The distribution and taxonomy of the three subspecies of Sharp-tailed Grouse that occur in British Columbia is uncertain, especially in northern parts of the province. Research is needed to determine taxonomic and distributional boundaries between the subspecies. The following information is based on the best information available:

"Columbian" Sharp-tailed Grouse– *T.p. columbianus*

This subspecies occurs from the Fraser River Basin Ecoregion near Vanderhoof south to Merritt in the Southern Thompson Upland Ecosection (Ritcey 1995). Breeding populations have been extirpated from grassland systems in the Pavillion ranges, east Kootenays (north and south of Cranbrook), and from the Okanagan Valley (D. Jury, pers. comm.). Recent confirmed sightings of lone adults, and additional unconfirmed records of breeding birds from the East Kootenays (D. Fraser, T. Antifeau. pers. comm.) suggest that peripheral individuals or populations are expanding northward from reintroduction attempts on the Tobacco Plains in Montana (Cope 1992).

"Plains" Sharp-tailed Grouse– *T.p. jamesi*

The "plains" subspecies in British Columbia occurs in the Peace Lowlands. Populations there are believed to be a continuum of a larger population that occurs east of the Rockies in central and southern Alberta (Figure 2) (Cannings 1998; Fraser et al. 1999).

"Alaskan" Sharp-tailed Grouse– *T.p. caurus*

The "Alaskan" subspecies has been reported only in Tagish Lake in the extreme northwestern portion of the province (Cannings 1998; Fraser et al. 1999).

A disjunct population of Sharp-tailed Grouse occurs in the northeastern portion of British Columbia including the Liard Basin and Fort Nelson Lowlands areas (Regions 6 and 7). It is unclear which subspecies ("Alaskan" or "Plains") occupies this portion of British Columbia. Cannings et al. (1998) describe the "Alaskan" (*T.p. caurus*) population as ranging from Alaska, through northwestern B.C. and the southern Yukon, to northern Alberta, while the range for the "plains" subspecies (*T.p. jamesi*) in B.C. is given specifically as the "Peace River District". Conversely, Fraser et al. (1999) refer to all northeastern sharp-tails as being *T.p. jamesi*, but they do not specifically include populations of the Liard/Ft. Nelson area. Likewise, Connelly et al. (1998) do not show sharp-tails occurring in northwestern B.C., but they clearly describe the Liard/Ft. Nelson populations as an extension of the "Alaskan" subspecies.

In summary, while the delineation of subspecies in northern B.C. is still somewhat uncertain and requires study, most current sources support *T.p. jamesi* as being the subspecies found around the Peace River Lowlands, while *T.p. caurus* is likely the subspecies that occurs in northwestern and extreme northeastern B.C., and possibly in suitable habitat in between (M. Chutter, D. Fraser, D. Jury, pers. comm.).

6 POPULATION SIZES AND TRENDS

6.1 Population Sizes

Population sizes of Sharp-tailed Grouse in British Columbia have been derived largely from density estimates in the various regions, and from localized long-term counts of males attending traditional dancing grounds (leks). The population size for "Columbian" Sharp-tailed Grouse in 1993 was estimated at 4600-10 000+ birds (Ritcey 1995). A more recent attempt to quantify population numbers, based on extrapolation of estimated densities across all potentially suitable habitats in the Thompson/Nicola and Cariboo regions, resulted in an estimate of 10 100 breeding birds in 2002 (D. Jury, P. Dielman, pers. comm.). Population sizes for the northern subspecies are unknown (B. Webster, pers. comm.).

Figure 2. The distribution and taxonomy of Sharp-tailed Grouse in British Columbia.

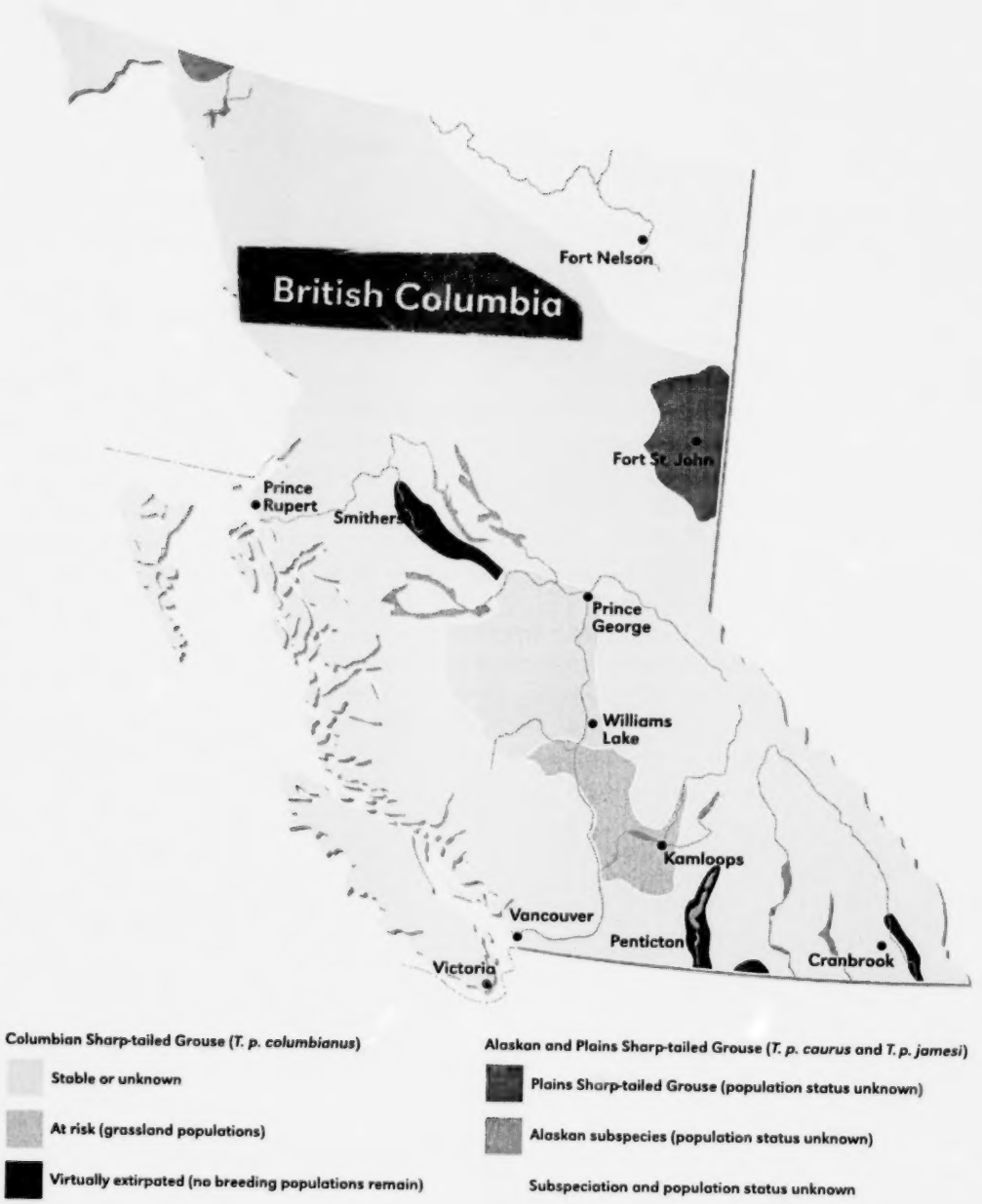

Figure 2. The distribution and taxonomy of Sharp-tailed Grouse in British Columbia.

6.2 Population Trends

Populations of Sharp-tailed Grouse have declined markedly since the advent of large-scale agricultural practices (Buss and Dziedzic 1955). This is especially true for all subspecies that inhabit climax grasslands in the United States and southern Canada. In Washington, Schroeder (2000) estimated a 92% population decline of "Columbian" sharp-tails since 1954.

In British Columbia, Cannings (pers. comm.) estimated that populations of the "Columbian" subspecies might have declined by as much as 70% since the early 1900's. Populations of the "Columbian" subspecies in climax grasslands of the south-central interior have been affected most, and thus, now constitute a small proportion of the total population in British Columbia (Ritcey 1995). Sharp-tails have been extirpated from the Okanagan and are virtually extirpated from the southern Rocky Mountain Trench (T. Antifeau, pers. comm.).

Assuming lek attendance is an indicator of population trends, regional MWLAP survey data since 1986 show a steady decline in Sharp-tailed Grouse lek attendance in the Thompson-Nicola region until 1998 when populations appeared to stabilize. From a peak in 1990 through to 1995, there was a 32% decline in male attendance at leks in the Thompson-Nicola grasslands (Figure 3). Furthermore, 13 of the 32 historical lek sites in this area, 13 (38%) have become inactive since 1986. MWLAP data for the Cariboo region also show a decline in male attendance at grassland lek sites between 1995 and 2001 (Figure 4). In one specific example, 46 grouse were found at a grassland lek site in the Cariboo region in 1989, but in 1993, only six birds were recorded at the site (Ritcey 1995).

In contrast to climax grassland populations, "Columbian" Sharp-tailed Grouse in forested areas in the Central Interior Ecoprovince are believed to have expanded in range and increased in numbers in the previous decade (Ritcey 1995; P. Dielmann, pers. comm.). This is believed to be due to increased habitat availability that resulted from large-scale timber harvesting of beetle-infested stands in 1987 (Cannings 2002; K. McKenzie, pers. comm.) This apparent increase in sharp-tail numbers is supported by higher hunter harvest in the years following logging (Figure 5). However, these populations are unlikely to persist since their existence depends on the distribution, size, and age of the harvested blocks. As forests regenerate and cutting intensity decreases, habitat suitability and

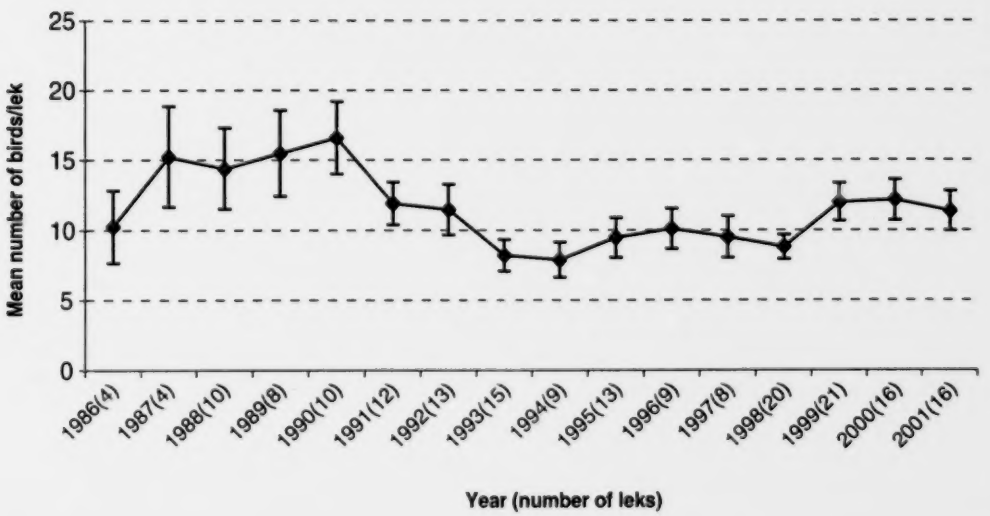

Figure 3. Average number of males attending leks in grasslands of the Thompson-Nicola region (source: MWLAP, Kamloops).

availability, and populations of Sharp-tailed Grouse will also decrease (P. Dielman, K, McKenzie, pers. comm.) (Figure 6).

Population size and trends for *T.p. jamesi* and *T.p. caurus* are largely unknown (Connelly et al. 1998). In 1984, B. Webster (pers. comm.), reported densities of 0.009 birds/km^2 (with a confidence interval of 28%) in the Liard and Fort Nelson Lowlands (subspecies unknown). He noted that populations in the Peace Lowlands were concentrated in agricultural settings along the Peace River (Wildlife Management Units 7-33 to 7-35), and that densities decreased northward and southward from there (see Figure 1). Hunter harvest data suggest that the sharp-tail population in Region 7B has declined (based on estimated kills and numbers of birds/hunter) since population highs were recorded in 1977 and 1987 (Figure 5). Historical declines may have been the result of removal of bison herds and fire suppression, which resulted in loss of open habitats. The perceived declines in more recent years are attributed to changes in land use (see trends in habitat quality and quantity above) (B. Webster, pers. comm.).

In Region 6 (MU 6-23), harvest numbers and hunter effort since 1976 have been extremely variable. However, the drop in hunter effort and estimated kills since 1994 may be a reflection of sharp-tail population declines.

7 LIMITING FACTORS AND THREATS

The persistence of viable populations in a given area depends primarily on the availability of suitable habitat to breed, nest, rear young, and overwinter. Historical declines in Sharp-tailed Grouse populations have been attributed to loss, fragmentation and degradation of habitat. Additional factors are winter severity, predation, hunting, and human disturbance.

7.1 Population

7.1.1 Disturbance

At leks, males are tolerant of a variety of disturbances, but are displaced by human presence. Disturbance of leks appears to limit reproductive opportunities, and may result in regional population declines (Baydack and Hein 1987).

Females appear to be more susceptible to various sorts of disturbance (Connelly et al. 1998). If females are flushed frequently during the early stages of

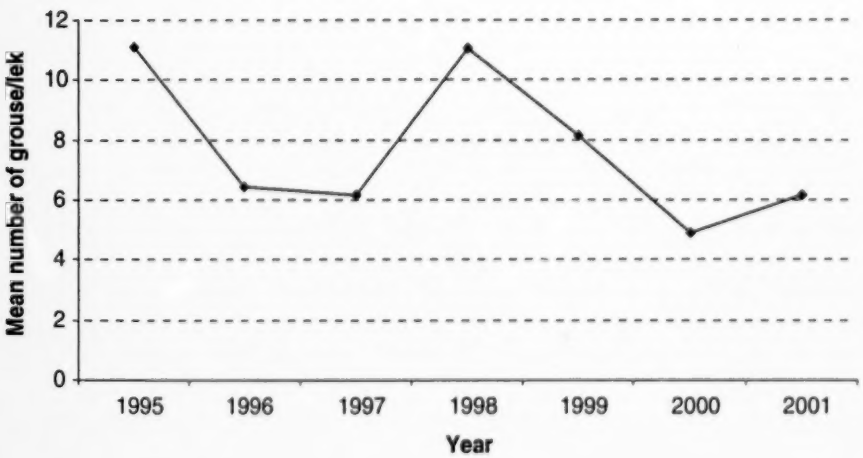

Figure 4. Average number of males attending leks in grasslands of the Cariboo region (source: MWLAP, Williams Lake).

oviposition, they may abandon the nest (T. Dickinson, pers. comm.). Excessive disturbance to wintering birds may impair their ability to cope with unfavourable winter conditions (Connelly et al. 1998; D. Jury, pers. comm.). In British Columbia, potential sources of disturbance include All Terrain Vehicles (ATV), hunting dog training and trials, mowing, and livestock presence.

7.1.2 Predation

Predation is commonly cited as the greatest source of direct mortality for Sharp-tailed Grouse (Cope 1982; Tirhi 1985; Marks and Marks 1987; Ritcey 1995; Connelly et al. 1998). Grouse are prone to predation because of their ground nesting habits, large clutch sizes (Hays et al. 1998) and lekking behaviour during the breeding season. Hays et al. (1998) also noted that predation rates partly depend on habitat quality.

Raptors and canids are major predators of Sharp-tailed Grouse. Marks and Marks (1987) reported that avian predators were responsible for 19 of 22 deaths of radio-collared sharp-tails in Idaho. In climax grasslands of southern interior B.C., incidental observations suggest that the main predators of sharp-tails are Coyotes (*Canis latrans*), Northern Goshawks (*Accipiter gentilis*), Short-eared Owls (*Asio flammeus*), Great Horned Owls (*Bubo virginianus*), and Red-tailed Hawks (*Buteo jamaicensis*) (Ritcey 1995; D. Jury, pers. comm.; E. Leupin, pers. obs.).

Periods of high predation appear to coincide with the breeding season when birds congregate at dancing grounds. During aerial searches in 1998, Coyotes were frequently spotted chasing sharp-tails at lek sites. Additionally, Red Foxes (*Vulpes vulpes*) have increased dramatically in numbers in northeastern B.C., and thus, may be affecting "plains" Sharp-tailed Grouse population dynamics (B. Webster, pers. comm.).

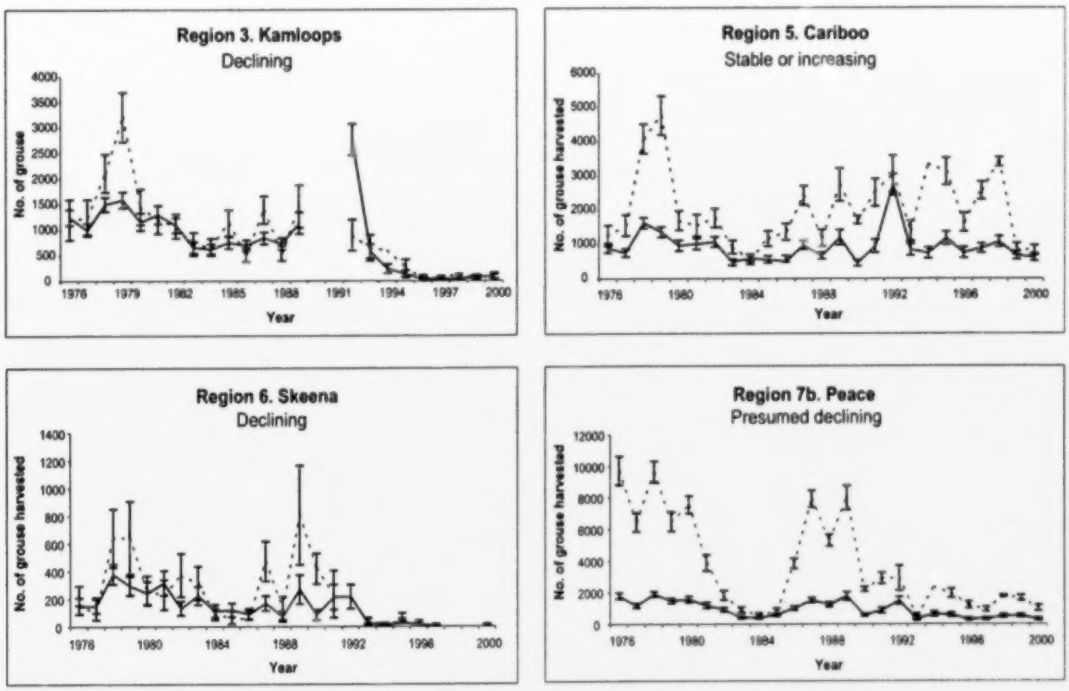

Figure 5. Number of hunters (solid line) and total Sharp-tailed Grouse harvest (dashed line) estimates for the various regions.

7.1.3 Hunting

Sharp-tailed Grouse are a popular gamebird where they occur in sufficient numbers to support hunting. (Ritcey 1995; Connelly et al. 1998). In British Columbia, all three subspecies have traditionally been hunted, but local area closures and bag limit restrictions have been implemented in recent years. Maximum daily and possession limits for both subspecies occurring in Wildlife Region 7B in northeastern B.C. were reduced from 10 to 3 and from 30 to 9, respectively, in 1990. A similar reduction was implemented in Wildlife Region 6 in northwestern B.C. in 1995 (M. Chutter, pers. comm.), however, all hunting opportunities for *T.p. caurus* in Wildlife Region 6 were closed in 2000 (M. Chutter, pers. comm.).

Over the past decades, hunting of "Columbian" sharp-tails has been severely curtailed. As of 2002, virtually all open grassland populations will be closed to hunting. Hunting currently remains open only in cutover habitat and sedge meadow complexes in the northern parts of the subspecies range (i.e., in the Cariboo and the northwestern portion of the Southern Interior Wildlife regions) (M. Chutter, pers. comm.). Daily bag and possession limits for these areas will remain at 5 and 10, respectively.

The effects of hunting on populations are poorly understood due to a lack of empirical evidence (Connelly et al. 1998). Indirect evidence suggests that hunting may not have an additive effect on mortality. In areas of Washington, Utah, and British Columbia, populations continued declining despite hunting closures (Hart et al. 1950; Schroeder 1996; Leupin 2000a). Conversely, Bergerud (1980) summarized hunting information from 10 studies and concluded that hunting increased annual mortality, rather than compensating for natural mortality during winter. However, these studies reported harvests in excess of 30% of the population, which is extremely high. Hunting at any harvest level may impact small isolated populations (Marks and Marks 1987). Timing of the hunting season may also affect local populations. For example, male birds congregating at dancing grounds during the fall could potentially be decimated or eradicated with repeated hunting visits to the lek location

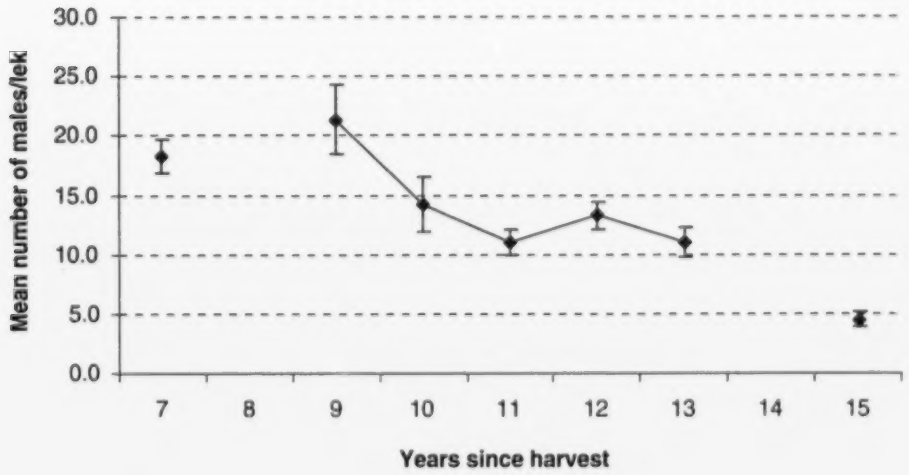

Figure 6. Average number of males visiting leks vs. years since harvest (n=3) in cutover habitat in the Cariboo.

(Ritcey 1995). Ritcey (1995) reported that at least two dancing grounds in climax grasslands were abandoned due to heavy hunting pressure the previous fall. Local extirpation could also occur if females visit lek locations; however, the degree to which females visit leks during fall congregations is unclear, although it has been reported (Lumsden 1965; Rippin 1970).

Despite hunting closures in certain areas, accidental shootings of Sharp-tailed Grouse may occur. In 2001, a hunter who was caught after having shot a Sharp-tailed Grouse in a closed area near the city of Kamloops claimed he was unaware of any hunting closures on the species (D. Jury, pers. comm.).

7.1.4 Pesticides

Ritcey (1995) provides anecdotal reports of mortalities caused by insecticides and surface applications of the rodenticide, Compound 1080. Other authors have suggested insecticide use can lead to population declines by causing both direct mortalities and losses of critical insect food resources (Bown 1980). Pesticides and rodenticides have been used extensively in B.C., and may have contributed to Sharp-tailed Grouse mortalities in the province (Ritcey 1995). However, the use of these products is now highly restricted and regulated, and is limited primarily to a few private holdings (Ritcey 1995).

7.2 Habitat

7.2.1 Grazing

Grazing by domestic livestock is considered to be the primary threat to Sharp-tailed Grouse populations in the United States and southern Canada (Hays et al. 1998). Continued heavy grazing causes changes in the vegetation community, and results in the loss of residual and live grass and forb cover required for nesting (Marks and Marks 1987; Ritcey 1995). Cattle can also have severe impacts on riparian areas, which provide critical foraging, roosting, and wintering areas for sharp-tails. Riparian habitats with gentle topography often receive heavy use by cattle since they provide easy access to water and shade (Gillen et al. 1985; Medin and Clary 1990). Browsing, rubbing, and trampling by cattle can cause loss of cover and vegetation structure in riparian habitats (Szaro and Pase 1983).

In Idaho, Marks and Marks (1987) noted that sharp-tails selected areas least impacted by cattle. Pepper (1972) noted similar behaviour by the "plains" subspecies in Alberta. Certain grazing regimes and high stocking rates can be detrimental to Sharp-tailed Grouse habitat (Klott and Lindzey 1990). For example, spring-fall rest rotation regimes provide adequate nesting cover in only one out of three years (Hays et al. 1998). Additionally, high cattle stocking rates during the sharp-tail nesting season can cause physical damage to roosting and nest sites, and may contribute to nest abandonment and/or destruction (Hays et al. 1998). In British Columbia, grazing occurs over much of the range of "Columbian" and "plains" Sharp-tailed Grouse. Lek abandonment, damage to important roosting/wintering areas, and nest damage have been reported in climax grasslands in the Thompson-Nicola region (Ritcey 1995; Leupin 2001; D. Jury, pers. comm.). Furthermore, the proliferation of fences on rangelands may be negatively impacting Sharp-tailed Grouse populations negatively by providing convenient perch sites for raptors (Pepper 1972; Tirhi 1995).

Although grazing practices have been identified as detrimental to sharp-tail populations in southern Canada and the Great Plains, historical grazing by bison may have maintained suitable habitat for populations in the Peace River Lowlands of British Columbia (B. Webster, pers. comm.). However, this hypothesis has not been tested and the potentially beneficial introduction of cattle grazing in the area has not been evaluated.

7.2.2 Fire

Fire has been identified as a potential threat to Sharp-tailed Grouse. Hays et al. (1998) reported that "Columbian" Sharp-tailed Grouse declines in shrub-steppe habitats in Washington were attributed to prescribed burning. Marks and Marks (1987) cautioned that severe fires would degrade habitat in a Sharp-tailed Grouse management area in Idaho. Hart et al. (1950) reported that a fire at a site in Utah impacted "Columbian" Sharp-tailed Grouse nesting and winter habitat, and caused the birds to abandon their lek.

Fires, however, can also have a positive impact on Sharp-tailed Grouse habitat. Fires that removed dense

sagebrush and wooded areas improved overall habitat conditions in Colorado, Wyoming, and Utah (Hart et al. 1950; Rogers 1969; Oedekoven 1985). In British Columbia, fires maintained climax grassland communities by reducing forest encroachment and ingrowth. Forested areas in British Columbia reach their peak potential to support Sharp-tailed Grouse only after they have been opened by fire or harvesting. Ritcey (1995) reported that in three areas, sharp-tails responded positively to stand-replacing fires. In northern British Columbia, sharp-tails have been observed using large-scale burns and fire-maintained muskegs (B. Webster, pers. comm.).

7.2.3 Fire suppression

Fire suppression is common in British Columbia. Statistics indicate that large-scale burns have decreased over the last half century (Ritcey 1995). Most habitat used by Sharp-tailed Grouse in British Columbia is maintained, primarily, by fire (Ritcey 1995; B. Webster, pers. comm.). In the absence of fire, habitat quality and quantity is reduced in areas prone to forest encroachment (Gayton 1998). At the landscape level, these vegetation changes can fragment and isolate habitats and populations (Berg 1990; Manley and Wood 1990; Dickson 1993). Forest encroachment is a significant issue in British Columbia. It has affected Sharp-tailed Grouse negatively (see Section 4.2 Trends in Habitat Quality and Quantity), and has been identified as a major contributing factor in the extirpation of Sharp-tailed Grouse in the southern Rocky Mountain Trench (Ohanjanian 1990).

7.2.4 Silvicultural practices

Forest harvesting has had a positive impact on all subspecies of Sharp-tailed Grouse in British Columbia. Large-scale operations, which were common in previous decades, have helped offset potentially deleterious effects of fire suppression and forest ingrowth. Areas of occupation and sizes of some populations have increased in response to openings created by large-scale harvesting. These increases, however, are generally short lived (approx.15 - 20 years; see Figure 6). Ritcey (1995) suggested that "Columbian" sharp-tail populations in forested areas would likely benefit indefinitely from logging practices. However, Cannings (2002) believes that current harvesting practices in those areas do not address local colonization/extinction dynamics and landscape level issues.

Forestry operations in B.C. truncate forest succession (Bunnell 1997). Activities such as planting, fertilizing, and mechanical site preparation can create obstacles for sharp-tail broods, and can affect the maintenance of sharp-tail habitats and winter forage species (Ritcey 1995).

8 SPECIAL SIGNIFICANCE OF THE SPECIES

8.1 North America

The three subspecies of Sharp-tailed Grouse (*T.p. jamesi, T.p. caurus* and *T.p. columbianus*) that occur in B.C. are also found in several other provinces and states. *T.p. caurus* and *T.p. jamesi* occur in the extreme northwest and northeast sections of the province. Although only anecdotal information is available for these subspecies, their representation in British Columbia likely makes up only a fraction of the North American population. Conversely, the "Columbian" subspecies now occupies less than 10% of its former range in North American (NatureServe Explorer 2002), but more than 60% of its original range in British Columbia (Ritcey 1995). Therefore, B.C. has a strong global responsibility to conserve this subspecies.

8.2 National and Provincial

Within Canada, the "Alaskan" subspecies is found in the Yukon, British Columbia, Alberta, and Saskatchewan. The "plains" subspecies occurs in British Columbia, Alberta, Saskatchewan and Manitoba (Campbell et al. 1990; Connelly et al. 1998).

The "Columbian" subspecies is only represented in B.C. Within British Columbia, stable populations of this subspecies can be found in sedge meadows and cutover areas in forested systems north of 70 Mile House (P. Dielman, pers. comm.). The grassland "Columbian" populations have shown significant declines and have been effectively isolated from populations inhabiting similar habitats in Washington. These populations then, are increasingly susceptible to extinction events associated with small isolated populations. It is not known whether forest opening and/or sedge

meadow ecotype populations from the northern part of the range of *T.p. columbianus* do, or could, serve as sources of re-colonization or "rescue effect" events. Recent sightings from the East Kootenays (T. Antifeau, pers. comm. to D. Fraser) are likely from reintroduction attempts and habitat management on the Tobacco Plains in Montana (Wood and Manley 1993).

8.3 Public Interest

Sage Grouse were extirpated from B.C. in the early 1900s; consequently, the Sharp-tailed Grouse is the only remaining tetraonid species in British Columbia that exhibits lekking behaviour. This makes it extremely sought after by the birding community; however, any efforts to create sharp-tail viewing sites should follow strict guidelines to ensure that disturbance to the birds is minimized.

The Sharp-tailed Grouse is also a favoured game bird in B.C. as it is the only native species that provides opportunity for open grassland bird hunting. Its tendency to hold is also highly valued by owners, breeders and trainers of pointer-retriever hunting dogs (Ritcey 1995).

9 EXISTING PROTECTION OR OTHER STATUS

The Sharp-tailed Grouse is a game species protected under the British Columbia *Wildlife Act* of 1982. Hunting closures for "Columbian" sharp-tails have been implemented in the Kootenays and the Okanagan (Wildlife Regions 4 and 8) since 1973 (M. Chutter, pers. comm.). All of the Thompson-Nicola region (Wildlife Region 3) except for Management Unit 3-31, has been closed to sharp-tail hunting since 1994. This gives protection to all the grassland populations, but leaves hunting open to populations in forest cutover in MU 3-31. In 2002, a closure will go into effect in the southern Cariboo (Wildlife Region 5) for MUs with open grassland populations. Thus, by 2002, all hunting of open grassland populations of the "Columbian" subspecies will be closed in B.C. Hunting of populations in less threatened forest clearing and wetland complex habitats in the northern part of the subspecies range will remain open, with bag and possession limits set at 5 and 15 birds, respectively.

Even though bag limits were reduced from 10 to 3, and possession limits were reduced from 30 to 9 in 1995, all hunting of sharp-tails was closed in Skeena region (Wildlife Region 6) in 1999 due to concerns of low numbers. This effectively closed most of the harvest of the "Alaskan" subspecies in the province. In the Peace District (Wildlife Region 7B), hunting remains open for "Alaskan" sharp-tails that occur along the Liard River and around Fort Nelson, and for "plains" sharp-tails that occur around the Peace Lowlands. Bag and possession limits, however, were reduced from 10 and 30 to 3 and 9, respectively, in 1990.

In 1993, as a result of regional extirpations and declines in grassland populations, the "Columbian" subspecies was designated as a vulnerable species-at-risk, and thus, was Blue- listed by the B.C. Wildlife Branch. Researchers at the Washington Department of Fish and Wildlife have recommended a threatened status for their "Columbian" sharp-tail populations (USFWS 1999).

In British Columbia, "Columbian" Sharp-tailed Grouse occur in several areas that have some degree of protection, including the Junction Range, Chilanko Marsh, Lac du Bois, Churn Creek and Itchas Ilgachuz. In northeastern British Columbia, existing protected areas have limited value for the "plains" subspecies because most areas do not support Sharp-tailed Grouse populations (B. Webster, pers. comm.)

Additional protection-related activities include a stewardship program for the "Columbian" subspecies initiated by Ministry of Environment, Lands, and Parks in Kamloops, B.C. in 1998. This project's objective is to raise awareness of the Sharp-tailed Grouse, and to promote stewardship opportunities with landowners, land users and government bodies.

10 RECOMMENDATIONS AND MANAGEMENT OPTIONS

10.1 Habitat

Habitat loss and degradation have been cited as the main factors responsible for the decline of the Sharp-tailed Grouse (Schroeder 2001). This is evident in climax grasslands of B.C.'s southern interior, and to a lesser extent, in the Peace River Lowlands (Campbell et al 1990; B. Webster, pers. comm.). Connelly et al. (1998) note that populations of "plains" and

"Columbian" sharp-tails generally respond positively to management practices that enhance or maintain nesting and winter habitats, and food sources. Range management strategies should make provisions for maintaining nesting cover, reducing forest encroachment, and protecting upland shrub communities and riparian habitats. The area within 2.5 km of an active breeding lek is believed to be critical to the management of nesting and brood-rearing habitats (Saab and Marks 1992; Giesen and Connelly 1993; Leupin 2001). Electric fencing can be used to create and maintain ungrazed areas and to protect shrub and riparian communities within the specified area. Salt licks, water troughs, electric fences, and herding can be used to keep cattle away from lek sites and nesting areas during peak activity periods. Ideal grass/forb height (residual and new growth) for nesting cover should not be less than 40 cm in 50% of the grass stand within a lek complex (MWLAP 2001). Grazing impacts on sharp-tail populations can vary depending on grazing intensity, duration, and regime, and on precipitation levels and past land use practices. Range management plans then, should be adaptive. MWLAP recommends that grazing use should not exceed 30% within a lek complex.

Fire, at proper frequencies and scale, can be a useful habitat management tool for stimulating plant growth and halting forest encroachment. Sharp-tailed Grouse populations have been reported to respond positively following fires (Ritcey 1995; Connelly et al. 1998). In areas where burns may not be practical or safe, encroaching tree seedlings should be removed manually.

Sharp-tails have also benefited from large-scale harvesting in forested areas (Ritcey 1995). These practices however are no longer the predominant harvest method and the resulting landscape matrix from current methods do not address Sharp-tailed Grouse habitat needs (Cannings 2002). Managers need to address retention of deciduous habitats adjacent to openings as well as temporal and spatial juxtaposition of newer openings to openings supporting Sharp-tailed Grouse complexes.

In cultivated lands, adequate densities of shrub thickets should be maintained. Disturbance to shrub habitats should be avoided in areas where they comprise less than 10% of the total occupied habitat (Connelly et al. 1998). In order to provide adequate nesting cover, natural openings should not be mowed or grazed. Conservation Reserve Programs (CRP) in the U.S. have benefited Sharp-tailed Grouse (Schroeder et al. 2000). Under the CRP program, large portions of privately owned lands are withdrawn from crop production and planted to native and non-native grasses, forbs, and shrubs (CRP; USDA 1986). Establishment of permanent cover on idle cropland under the CRP program has been used to significantly enhance and enlarge suitable habitat (Sirotnak et al. 1991; Giesen and Connelly 1993) for the "Columbian" subspecies in Colorado, Idaho, Oregon, Utah, and Washington (USFWS 1999). Similar programs could improve habitat for the "plains" subspecies in the Peace River Lowlands.

10.2 Inventory and Monitoring

Inventory and monitoring efforts are important for measuring (directly or indirectly) the effectiveness of management actions. Lek size and densities provide an index to populations and indirectly reflect changes in habitat quality (Cannon and Knopf 1981; Giesen and Connelly 1993).

Regular surveys of known leks of *T.p. columbianus* are undertaken in Wildlife Regions 3 and 5 (Southern Interior and Cariboo). Little information is available for the "Columbian" subspecies in its northern forested and wetland complex habitats, and almost no information is available for the *T.p. caurus* and *T.p. jamesi* (B. Webster, pers. comm.). Monitoring efforts to identify new and previously unknown leks in all areas of their range should be initiated or expanded. Initial efforts should focus on lek counts and lek densities (M. Schroeder, pers. comm.). Resource Inventory Committee standards suggest that surveys to document new or previously unknown leks should be undertaken in the spring (April to mid-May). Survey techniques include listening for vocalizations at dawn during spring lekking activities, attempting to generate call responses using tape playback, or searching suitable habitat with trained dogs. In large inaccessible areas, the use of a fixed-wing aircraft is recommended (Leupin and Murphy 1998). In the spring of 1998, 11 previously unknown leks were located using this

method in grasslands of the Thompson-Nicola region (Leupin and Murphy 1998).

10.3 Extension

Extension activities can be powerful conservation tools for educating resource users about issues of concern. Printed materials, media coverage, and interpretive signs placed in strategic areas can help reduce accidental mortality and disturbance to Sharp-tailed Grouse. Education efforts should be aimed at major landowners and grazing lease holders who graze areas in Sharp-tailed Grouse habitat. This can be achieved by developing and implementing on-site workshops and demonstration projects where Sharp-tailed Grouse habitat needs and management tools are identified and discussed.

10.4 Reintroductions

Reintroduction attempts have been made in Montana, Oregon (Snyder et al 1999; Cope 1992) and other states with mixed results. Reintroduction efforts in Montana appear to have augmented the remnant population of sharp-tails in the East Kootenays (T. Antifeau, pers. comm.). Attempts to reintroduce Sharp-tailed Grouse into previously unoccupied habitats, and captive breeding and release reintroduction efforts have not been successful (Merker 1996; NatureServe Explorer 2002). In British Columbia, options for reintroductions or augmentations exist in the Okanagan Valley, Southern Rocky Mountain Trench and Bulkley Basin. However, reintroduction success depends largely on the availability, quantity and quality of suitable habitat. Connelly et al. (1998) report that 30 km^2 is the minimum total habitat area necessary for successful population persistence or reintroduction. Thirty-three percent of this area should be undisturbed grass-shrub habitat; the remainder should be composed of cropland, pasture, and grazed uplands. A Habitat Suitability Index (HSI) developed and tested for *T.p. jamesi* and *T.p. columbianus* is likely a useful tool for evaluating habitat prior to reintroduction efforts (Gardner 1997; Meints et al. 1992;Prose 1987).

Re-establishment of populations is significantly increased if the project is long-term (>5yr), and employs a soft release technique (birds are acclimated in on-site enclosures prior to the release) of 100+ birds annually. Additional important factors include matching ecotypes to appropriate habitats, addressing predator issues, and protecting habitat within a critical 2.5 km radius (lek complex) (Cope 1982; Connelly et al. 1998).

10.5 Hunting

Closed hunting seasons are recommended for small, isolated, or declining populations of Sharp-tailed Grouse (Marks and Marks 1987). In British Columbia, hunting closures are in effect for all threatened "Columbian" grassland populations. To avoid possible confusion, closures should be clearly noted in the hunting regulation synopsis. Greater emphasis should be placed on upland bird and listed species recognition in the wildlife section of the Conservation Outdoor Recreation Examination (CORE).

10.6 Research Needs

B.C. supports three subspecies of Sharp-tailed Grouse which occur in a variety of habitats from climax grasslands to primarily forested landscapes. Much of our knowledge of these birds is drawn from studies of the "Columbian" and "prairie" subspecies in prairie and shrub-steppe habitats outside of British Columbia. Deriving management guidelines based on studies from other areas and other habitat types is of limited value.

In general, our state of knowledge of the two northern subspecies is poor. Although government wildlife officials have expressed concern about the status of these subspecies, almost no quantitative information about them has been collected (B. Webster, pers. comm.). In British Columbia, several small-scale studies have shed some light on basic ecological needs of "Columbian" Sharp-tailed Grouse in climax grasslands. However, basic studies are needed to identify, population sizes, source/sink dynamics, and habitat associations of all subspecies so that the species, as a whole, can be properly managed. Furthermore, there is a need to conduct taxonomic studies to verify the distribution of each subspecies. Initial steps have been taken to determine genetic variation among "Columbian" populations. Further studies should

address subspeciation and distribution of *T.p. jamesi* and *T.p. caurus*. Such work will help determine range boundaries of all three subspecies and will help set conservation priorities.

11 EVALUATION

11.1 General

Sharp-tailed Grouse occur in several disjunct populations in B.C. The "Alaskan" subspecies occurs in the extreme northwest section of the province, mostly in forest openings in the Skeena region. The "plains" subspecies is found in forest openings and agricultural clearings in the Peace River Lowlands of northeastern B.C. The population that occurs in the Liard Basin and the Fort Nelson Lowlands is believed to be an extension of the "Alaskan" subspecies, but this needs verification. The "Columbian" subspecies occurs in forest openings, sedge meadow complexes, and climax grasslands in the south-central interior, although recent sightings in the East Kootenays suggest that remnant populations may persist or may be have been augmented by reintroduction efforts in Montana (Cope 1992). Management objectives for all subspecies should involve developing standardized monitoring protocols and adaptive management strategies to mitigate identified impacts on habitat and populations.

Little is known about the two northern subspecies, although anecdotal information suggests that declines may have occurred within the last 25 years. The lack of quantitative data precludes the assignment of a proper status ranking for them. Basic research is needed to provide at least baseline population and habitat availability data.

For the "Columbian" subspecies, long-term lek surveys suggest a declining trend for permanent grassland populations, whereas populations in forested and wetland systems appear to be stable or expanding in distribution. The factors responsible for the declines are commensurate with those observed elsewhere in their range. The rankings presented below pertain to this subspecies and are based on information provided by the Conservation Data Centre (CDC). The criteria used follow the guidelines outlined by Harcombe (2000).

11.2 Rankings

Est. No. of Occurrences in the Province: C: 100+

Comments: There are about 70-140 sub-populations (lek groups and isolated leks) (P. Dielman, D. Jury, pers. comm.).

Abundance: C/D: >13,500

Comments: The 2001 breeding population was estimated at 10 100 (P. Dielman, D. Jury, pers. comm.). About 30% of these are confined to true grasslands, the remainder are in early seral clearcuts associated with sedge meadows or grassland edges. In 1993, the breeding population was estimated at 4600-10,000+ based on an extrapolation of lek counts (Ritcey 1995).

Range: B: 3-10% of the Province

Comments: The range of viable populations (minimum convex polygon) is estimated to be roughly 60 000 km^2, within that range, populations are confined to local areas of the Thompson Uplands, Thompson Basin, Nechako Lowland, Chilcotin Plateau, Cariboo Basin, and Fraser River Basin. Not included in this range calculation are localized and probably non-viable populations in the grasslands of the southern Rocky Mountain Trench. Populations in the Bulkley Basin and Okanagan Valley are considered to be extirpated (Campbell et al. 1990; Ritcey 1995). The amount of actual occupied habitat has been estimated at 15 000 km^2 (D. Jury, pers. comm.).

Trend: BC: Declining/Stable

Comments: The distribution of this subspecies in British Columbia has contracted markedly over the past 100 years, and probably 70% of the population has been lost. It is now extirpated from the Okanagan and Bulkley Valleys, and is extirpated as a breeding species from the southern Rocky Mountain Trench (Cannings et al. 1987; Ohanjanian 1990; Ritcey 1995). Remaining bunchgrass grassland populations continue to decline, although lek count data indicate some stabilization may have occurred since 1995.These populations now constitute a small proportion of the total population in British Columbia. There have been declines observed in many of the leks in the Thompson-Nicola region, with some becoming inactive (Leupin 2000a; D. Jury, pers. comm). The larger

northern populations appear to be stable or increasing in clearcut habitats (Ritcey 1995; P. Dielman, pers. comm.).

Protected Occurrences: B: At least One Protected Occurrence

Comments: Several occurrences are partially protected: Junction Range, Lac du Bois, Churn Creek and others.

Threats: AB: Moderately Threatened/Very Threatened

Comments: In the northern part of the range, the clearcut habitats used by these birds are not severely threatened at larger scales, but individual areas provide suitable habitat for only 10-20 years. Still, this species is dependent on on-going intervention there for its survival, and current logging practices are not designed to create mosaics of habitat for this species; benefits to the species are "accidental". Threats are much more extreme in the southern and central part of the subspecies' range, even though hunting has been curtailed. Grassland and riparian woodland habitats have been lost to urban and agricultural development (Cannings et al. 1987), and extensive grasslands have been lost to forest encroachment (Hooper and Pitt 1995). In the Kootenays, important wintering riparian habitat has been lost to flooding. Livestock overgrazing has been implicated with a loss of nesting cover. Cattle in riparian zones can impact shrubs, which provide a winter food source for Sharp-tailed Grouse (Connelly et al. 1998). While males are tolerant of human disturbance, females avoid disturbed leks, thus affecting overall reproductive success (Baydeck and Hein 1987). Females on their nests are also susceptible to disturbance. Small remnant populations are susceptible to overhunting and accidental killing (Ritcey 1995).

Other Considerations:

This subspecies has disappeared over much of its global range in northwestern North America. This pattern is continuing in southern British Columbia, and there is little possibility of "rescue" effects from adjacent jurisdictions. The grasslands and clearcuts/sedge meadows of south-central British Columbia are this subspecies' last stronghold. It is clearly a very vulnerable/at-risk/threatened species.

Rank and Reasons

Provincial Rank: S3

Date Last Reviewed: 01-12-06

Reasons for Rank: Populations of Sharp-tailed Grouse have been extirpated from the Okanagan and are virtually extirpated from the Kootenays. Habitat and populations are declining and under threat in the Thompson-Nicola region. Populations have expanded into new clearcut areas, especially on the Chilcotin plateau, but these habitats are not viable in the long-term. The great decline of this species elsewhere in its range indicates that it is very sensitive to habitat loss and degradation.

12 LITERATURE CITED

Alberta Prairie Conservation Action Plan. 2001. Available: http://www.albertapcf.ab.ca/index.htm

Aldous, Shaler E. 1943. Sharp-tailed Grouse in the sand dune country of north-central North Dakota. J. Wildl. Manage. 7:23-31

Ammann, C.A. 1963. Status and management of Sharp-tailed Grouse in Michigan. J. Wildl. Manage. 27:802-809.

Baydeck, R.K., and D.A. Hein. 1987. Tolerance of Sharp-tailed Grouse to lek disturbance. Wildl. Soc. Bull. 15:535-539.

Berg, W.E. 1990. Sharp-tailed Grouse management problems in the Great Lakes states: does the sharp-tail have a future? Loon 62:42-45.

Bergerud, A.T. 1988. Population ecology in North American Grouse. Pages 578-685 *in* A.T. Bergerud and M.W. Gratson, eds. Adaptive strategies and population ecology in northern grouse. Vol. 2. Univ. Minnesota Press, Minneapolis, MN.Bown, R.R. 1980. The status of the Columbian Sharp-tailed Grouse in the Tobacco Plains, Eureka, Montana. B.Sc. Thesis. Univ. Montana, Missoula, MT. 42pp.

Bunnell, F.L. 1997. Operational criteria for sustainable forestry: Focussing on the essence. For. Chron. 73:679-684.

Buss, I.O., and E.S. Dziedzic. 1955. Relation of cultivation to the disappearance of the Columbian Sharp-tailed Grouse from southeastern Washington. Condor May 1955.

Campbell, R.W., N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M. C.E. McNall. 1990. The Birds of British Columbia. Vol 2. Royal B.C. Mus., Victoria, BC. 636pp.

Cannings, R.J. 1998. The birds of British Columbia - a taxonomic catalogue. B.C. Minist. Environ., Lands and Parks, Victoria, BC. 266pp.

Cannings, S. 2002. Sharp-tailed Grouse Ranking Report. B.C. Conservation Data Centre. Unpubl. Man., Victoria, BC.

Cannings, R.A., R.J. Cannings, and S.G. Cannings. 1987. Birds of the Okanagan valley, British Columbia. Royal B.C. Mus., Victoria, BC. 420pp.

Cannon, R.W., and F.L. Knopf. 1981. Lek numbers as a trend index to prairie grouse populations. J. Wildl. Manage. 45:776-778.

Connelly, J.W., M.W. Gratson, and K.P. Reese. 1998. Sharp-tailed Grouse (*Tympanuchus phasianellus*). *In* A. Poole and F. Gill, eds. The Birds of North America. No. 354. The Birds of North America, Inc., Philadelphia, PA. 20pp.

Cope, M.G. 1992. Distribution, habitat selection and survival of transplanted Columbian Sharp-tailed Grouse in the Tobacco Valley, Montana. M.Sc. Thesis. Montana State Univ., Bozeman. MT. 60pp.

Evans, K.E. and A.N. Moen. 1975. Thermal exchange between Sharp-tailed Grouse (*Pediocetes phasianellus*) and their winter environment. Condor: 77:160-168.Fraser, D., B Harper, S. Cannings, and J. Cooper. 1999. Pages 62-64 in Rare birds of British Columbia. B.C. Minist. Environ., Lands and Parks, Wildl. Branch and Resour. Inventory Branch, Victoria, BC.

Gardner, S.C. 1997. Movements, survival, productivity, and test of a habitat suitability index model for reintroduced Columbian Sharp-tailed Grouse. M.Sc. Thesis, Univ. Idaho, Moscow, ID. 90pp.

Gayton, D. 1998. Preliminary calculation of excess forest in-growth and resulting forage impact in the Rocky Mountain Trench. Unpubl. Draft Rep., B.C. Minist. For. Nelson Region. 6pp.

_____, T. Braumandl, and R. Stewart. 1995. Ember - ecosystem maintenance burning evaluation and research. Problem analysis and working plans. B.C. For. Serv. Nelson Region. 52pp.

Giesen, K.M. 1987. Population characteristics and habitat use by Columbian Sharp-tailed Grouse in northwest Colorado. Final Rep., Colorado Div. Wildl. Fed. Aid Project W-1 52-R.

_____, and I.W. Connelly. 1993. Guidelines for management of Columbian Sharp-tailed Grouse habitats. Wildl. Soc. Bull. 21(3):325-333.

Gillen, R.L., W.C. Krueger, and R.F. Miller. 1985. Cattle use of riparian meadows in the Blue Mountains of Northeastern Oregon. J. Range Manage. 38:205-210.

Gratson, M.W. 1988. Spatial patterns, movements, and cover selection by Sharp-tailed Grouse. Pages 158-192 *in* A.T Bergerud and M.W. Gratson, eds. Adaptive strategies and population ecology of northern grouse Univ. Minnesota Press, Minneapolis, MN.

_____, G.K. Gratson, and A.T. Bergerud. 1991. Male dominance and copulation disruption do not explain variance in male mating success on Sharp-tailed Grouse (*Tympanuchus phasianellus*) leks. Behaviour 118:187-213.

Hamerstrom, F.N. 1939. A study of Wisconsin's Prairie Chickens and Sharp-tailed Grouse. Wilson Bull. 51:105-120.Hamerstrom, F.N., Jr., and F. Hamerstrom. 1961. Status and problems of North American grouse. Wilson Bull. 73:284-294.

Harcombe, A.P. 2000. The Conservation Data Centre: for the greatest about the least. Pages 13-17 *in* L.M. Darling, ed. At Risk: proceedings of a conference on the biology and management of species and habitats at risk. February 15-19, 1999. Univ. College of the Cariboo. Kamloops, BC.

Hart, C.M., O.S. Lee, and J.B. Low. 1950. The Sharp-tailed Grouse in Utah: its life history, status and management. Pub. No. 3, Utah State Dep. Fish and Game.

Hays, D.W., M.J. Tirhi, and D.W. Stinson. 1998. Washington State status report for the Sharp-tailed Grouse. Wash. Dep. Fish and Wildl. Olympia, WA. 57pp.

Hooper, T.D., and M.D. Pitt. 1995. Problem Analysis for Chilcotin-Cariboo grassland biodiversity. B.C. Minist. Environ., Lands, and Parks, Wildl. Branch, Victoria, BC. Bull. B-82. 116pp.

Johnsgard, P.A. 1973. Grouse and Quail of North America. Univ. Nebraska Press, Lincoln, NE.

Johnsgard, P.A. 1983. Grouse of the World. Univ. Nebraska Press, Lincoln, NE.

Klott, J.H., and F.G. Lindzey. 1990. Brood habitats of sympatric sage grouse and Columbian Sharp-tailed Grouse in Wyoming. J. Wildl. Manage. 54:84-88.

Kobriger, J. 1995. Graph of lek counts 1956-95, Billings Co., North Dakota. *In* Prairie Grouse Technical Council Proc., 21st biennial meeting. Aug. 28-31, 1995. Medora, ND.

Leupin E.E. 2000a. Population trends of the Sharp-tailed Grouse in the Thompson-Nicola Region. Unpubl. Rep. B.C. Minist. Environ., Lands, and Parks, Kamloops, BC.

_____. 2000b. 1998-2000 Sharp-tailed Grouse lek inventory project. Unpubl. Rep. Minist. Environ., Lands, and Parks, Kamloops, BC.

_____. 2001. Columbian Sharp-tailed Grouse nesting and brood-rearing habitat in the Lac du Bois Grassland Provincial Park. Unpubl. Rep. B.C. Parks, and Minist. Air, Water, and Land Protection, Kamloops, BC.

_____, and M.J. Murphy 1998. Habitat characterization and inventory of Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*) in the Thompson-Nicola Sub-region. Unpubl. Rep. B.C. Minist. Environ., Lands, and Parks, Kamloops, BC.

Lumsden, H.G. 1965. Displays of the Sharp-tailed Grouse. Ontario Dep. Lands and For. Tech. Ser. Res. Rep. 66.

Manley, T. and M. Wood. 1990. The status of Columbian Sharp-tailed Grouse on the Tobacco Plain, Eureka, Montana. Final Rep. MDFWP, Kalispell, ID. 25pp.

Marks, J.S., and V.S. Marks. 1987. Habitat selection by Columbian Sharp-tailed Grouse in west-central Idaho. U.S. Bur. Land Manage., Boise Dist., Boise, ID.

_____. 1988. Winter habitat use by Columbian Sharp-tailed Grouse in western Idaho. J. Wildl. Manage. 52:743-746.

Medin, D.E., and W. P. Clary. 1990. Bird and small mammal populations in a grazed and ungrazed riparian habitat in Idaho. U.S. Dep. Agric. For. Serv. Res. Paper INT-425. Ogden, UT.

Meints, D.R. 1991. Seasonal movements, habitat use and productivity of Columbian Sharp-tailed Grouse in southeastern Idaho. M.Sc. Thesis, Univ. Idaho, Moscow, ID. 74pp.

_____, J.W. Connelly, K.P. Reese, A.R. Sands, and T.P. Hemker. 1992. Habitat suitability index procedure for Columbian Sharp-tailed Grouse. Stat. Bull. 55. Idaho For., Wildl. and Range Exp. Stn, Univ. Idaho, Moscow, ID. 27pp.

Merker, C. 1996. Captive rearing and release of Columbian Sharp-tailed Grouse. M.Sc. Thesis. Eastern Washington Univ., Cheney, WA. 48pp.

Miller, G.C. and W.D. Graul. 1980. Status of Sharp-tailed Grouse in North America. Pages 18-28 *in* P.A. Vohs and F.L. Knopf, eds. Proc. Prairie Grouse Symp. Oklahoma State Univ., Stillwater, OK.

Ministry of Forests, Range Section, Forest Practices Branch. 1999. Forest in-growth and encroachment: a provincial overview from a range management perspective.

Ministry of Water, Land, and Air Protection. 2001. Has the Range of the Columbian Sharp-tailed Grouse Changed? Available: http://wlapwww.gov.bc.ca/soerpt/5wildlife/grouse.html

Mossop, D. 1979. Seral habitat usage by Sharp-tailed Grouse in the Yukon Territory-an hypothesis. Pages 196-199 *in* M. Hoefs, and D. Russell, eds. Wildlife and wildfire: Proceedings of workshop. November 27-28, 1979; Whitehorse, YT. Yukon Wildl. Branch, Whitehorse, YT. [14085] for information on STGR in Yukon

Moyles, D.L.J. 1981. Seasonal and daily use of plant communities by Sharp-tailed Grouse (*Pedioecetes phasianellus*) in the parklands of Alberta. Can. Field-Nat. 95:287-291.

_____, and D.A. Boag. 1981. Where, when and how male Sharp-tailed Grouse establish territories on arenas. Can. J. Zool. 59:1576-1581.

NatureServe Explorer: An online encyclopedia of life [web application]. 2002. Version 1.6. Arlington, Virginia, USA: NatureServe. Available: http://www.natureserve.org/explorer. (Accessed: January 24, 2002).

Oedekoven, O.O. 1985. Columbian Sharp-tailed Grouse population distribution and habitat use in south central Wyoming. M.Sc. Thesis, Univ. Wyoming, Laramie, WY. 58pp.

Ohanjanian, I. A. 1990. The Columbian Sharp-tailed Grouse in the East Kootenay: a report on their status and options for reintroduction. Bioquest International Consulting, Kimberley, BC. 55pp.

Pepper, G.W. 1972. The ecology of Sharp-tailed Grouse during spring and summer in the aspen parklands of Saskatchewan. Sask. Dep. Nat. Resour. Regina, Sask. Wildl. Rep. 1. 55pp.

Prose, B.L. 1987. Habitat suitability index models: plains Sharp-tailed Grouse. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.142). 31pp.

Ritcey, R. 1995. Status of the Sharp-tailed Grouse-*columbianus* subspecies-in British Columbia. B.C. Minist. Environ., Lands, and Parks, Wildl. Branch, Victoria, BC. Wildl. Working Rep. No. WR-70pp.

Rippin, A.B. 1970. Social organization and recruitment on the arena of Sharp-tailed Grouse. M.Sc. Thesis, Univ. Alberta, Edmonton, AB.

Robel, R.J., F.R. Henderson, and W. Jackson. 1972. Some Sharp-tailed Grouse population statistics from South Dakota. J. Wildl. Manage. 36:87-98.

Rogers, G.E. 1969. The Sharp-tailed Grouse in Colorado. Colorado Game, Fish and Parks Dep. Tech. Publ. 23. 94pp.

Ross, T.J. 1997. Forest in-growth and forest encroachment on Bald Mountain and Bechers Prairie between 1962 and 1993/95. Prep. for B.C. Minist. Agric., Cariboo/Chilcotin Grazing Enhancement Fund. Ross Range and Reclamation Serv., Cranbrook, BC. 40pp.

Saab, V.A., and J.S. Marks. 1992. Summer habitat use by Columbian Sharp-tailed Grouse in western Idaho. Great Basin Nat. 52:166-173.

Sauer, J. R., J. E. Hines, and J. Fallon. 2001. The North American Breeding Bird Survey, Results and Analysis 1966 - 2000. Version 2001.2, USGS Patuxent Wildlife Research Center, Laurel, MD. Available: http://www.mbr-pwrc.usgs.gov/bbs/

Schroeder, M.A. 1994. Progress report. Productivity and habitat use of Sharp-tailed Grouse in north-central Washington. Unpubl. Rep., Wash. Dep. Fish and Wildl., Olympia.

_____. 1996. Progress report. Productivity and habitat use of Sharp-tailed Grouse in north-central Washington. Unpubl. Rep., Wash. Dep. Fish and Wildl., Olympia.

_____, D.W. Hays, M.A. Murphy, and D.J. Pierce. 2000. Changes in the Distribution and Abundance of Columbian Sharp-tailed Grouse in Washington. Northwestern Nat. 81:95-103.

Sexton, D.A., and M.M. Gillespie. 1979. Effects of fire on the location of a Sharp-tailed Grouse arena. Can. Field-Nat. 93(1):74-76.

Sirotnak, J.M., K.P. Reese, J.W. Connelly, and K. Radford. 1991. Effects of the Conservation Reserve Program (CRP) on wildlife in southeastern Idaho. Idaho Dep. Fish and Game Job Completion Rep., Proj. W-160-R-18.

Snyder, J.W., E.C. Pilren, and J.A. Crawford. 1999. Translocation histories of prairie grouse in the United States. Wildl. Soc. Bull. 27(2):428-432.

Szaro, R.C. and C.F. Pase. 1983. Short-term changes in a cottonwood-ash-willow association on a grazed and an ungrazed portion of Little Ash Creek in central Arizona. J. Range Manage. 36: 382-384.

Tirhi, M.J. 1995. Washington State management plan for Sharp-tailed Grouse. Wildl. Manage. Prog., Wash. Dep. Fish and Wildl, Olympia, WA.

Ulliman, M.J. 1995. Winter habitat ecology of Columbian Sharp-tailed Grouse in southeastern Idaho. M.Sc. Thesis, Univ. Idaho, Moscow, ID.

United States Department of Agriculture (USDA). 1986. Conservation Reserve Program: outline and administration handbook. Conserv. Reserve Program Deputy Adm., State and County operations, Washington, DC.

U.S. Fish and Wildlife Service (USFWS). 1999. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the Columbian Sharp-tailed Grouse as threatened. Fed. Register: Oct. 26, 1999. Vol. 64, No. 206: pp. 57620-57623.

Van Rossum, G. 1992. Habitat of the Columbian Sharp-tailed Grouse in the southern interior of British Columbia. Unpubl. Rep. B.C. Minist. Environ. Lands, and Parks, Kamloops, BC.

Vance D.R., and R.L. Westeneier. 1979. Interactions of pheasants and prairie chickens in Illinois. Wildl. Soc. Bull. (7):221-225

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